Portable Electron Beam Gun Specifications

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A. Introduction: This electron beam gun will be incorporated in an electron beam freeform fabrication system that will be flown on a microgravity research aircraft and/or operated in laboratory facilities at NASA Langley that are capable of simulating the atmosphere on Mars. The application requires minimized size and weight of the electron beam gun and all support hardware to maintain portability. Thus, minimized support hardware, such as elimination of auxiliary cooling systems is essential for the application.

B. Technical Requirements:

1. The electron beam gun system shall consist of electron beam gun and all associated power supplies, controls, and instrumentation necessary for safe operation per specifications below.

2. The weight of the portion of the electron beam gun inserted into the chamber, exclusive of the cables, shall not exceed 75 pounds.

3. The electron beam gun shall have sufficient power density to melt aluminum, titanium, and steel alloys with a molten zone penetration depth of 0.1 inch or greater.

4. The accelerating voltage shall be a minimum of 60 kV with a preference for the ability to change accelerating voltages in real time during operation. Electron beam current shall be programmable in 1.0 mA steps or smaller over a range of 0 to 125 mA or higher to obtain an output beam power of a minimum of 10 kW continuous.

5. The input power shall be 208 V, 3 phase, 60 Hz.

6. The electron beam controls shall include all necessary magnetic focusing coils, deflection coils, and electronic power controls to allow use of a focused or defocused beam for controlling the beam size and power density during operation. As a minimum, the beam spot size shall be focusable over the range of 0.010 in. – 0.090 in. diameter at a power of 10 kW and a gun-to-work distance of 2 in. – 3 in.. The deflection coils shall permit the stationary (not rastered) deflection of the beam from 0° (parallel to Z axis) to 5° in any X-Y direction. NASA prefers a system capable of focusing the beam to a smaller spot size and programmably control and deflect the beam.

7. The gun filament shall be of robust design to survive numerous on/off cycles and long durations of 1 hour or longer of continuous operation at 10 kW continuous power or higher. The vendor shall deliver a minimum of 3 spare filaments with the system. Filament installation and access shall be designed to allow easy filament change in less than 1 hour without use of special tools or fixtures.

8. The electron beam gun shall be designed for mounting entirely within a vacuum chamber and shall include all necessary mounting flanges and vacuum chamber feedthroughs (electrical and/or mechanical). All flanges and fittings for vacuum chamber feedthroughs shall be of industry standard conflat type.

9. The high voltage cable shall be a minimum of 30 feet in length to allow for moving the gun inside of the vacuum chamber.

10. The gun shall be designed for operation in an ambient environment of 10 torr or higher pressure. The gun shall be insulated to prevent corona discharge from occurring in the 10 torr environment in the vacuum chamber. If the filament must be maintained at a lower vacuum to avoid arc discharge, the gun shall be designed to protect the filament from degradation due to the ambient environment.

11. All support hardware (including required controllers and power supplies), shall be rack-mountable. Connections between support hardware and electron beam gun shall be designed to allow quick disconnect and reconnect for enhanced portability, but have locking connectors to prevent inadvertent disconnection as a result of external vibrations.

12. The electron beam controls shall be capable of being interfaced with higher level PC-based control system using LabView software for process sequencing commands. Operator interface shall be remote from electron beam gun.

13. The electron beam gun shall be designed to meet or exceed all OSHA guidelines for electrical high voltage and x-ray generation safety. Power supplies and high voltage sources shall be designed to eliminate the danger of corona discharge in the event of a drop in atmospheric pressure due to aircraft cabin depressurization. The equipment shall meet the requirements of NASA flight aircraft safety standards, reference documents AOD 33897 and AOD 33912. The standards may be obtain from the following website: http://jsc-aircraft-ops.jsc.nasa.gov/Reduced_Gravity/guides.html

C. Additional Requirement and Deliverables:

1. Contractor shall provide written monthly status reports that include percent complete for design and fabrication, a brief summary of work completed during the previous month in design and fabrication, and any required completion date variances. These written monthly status reports shall be provided via e-mail to the technical monitor.

2. Informal review via telecon within 45 days after signing contract. Project schedule, identification of components from outside vendors, detailed preliminary design including materials of fabrication shall be provided in advance of the review and discussed during this review.

3. Complete final specifications on all purchased components, and final dimensioned drawings, weights within 3 months ARO.

4. The vendor shall support a demonstration of operation at offeror's facility prior to shipment.

5. Delivery of system to NASA Langley Research Center within 12 months of award.

6. The offeror shall provide two sets of the following documentation: complete parts list, electrical and mechanical schematics, and all necessary operation, maintenance, and programming manuals with the system.

7. The offeror shall deliver two sets of any specialty tools required for electron beam gun maintenance or filament changes at the time of system delivery.

8. Completion of 8 hours of training at NASA Langley Research Center within 2 weeks of delivery.

D. Option Item: Fabricate and deliver a second gun identical to the gun designed to satisfy all requirements outlined above. At the time of exercising the Option, the Contractor shall provide a schedule for the work to be performed, not to exceed 12 months.